

a drilling fluid having a pH greater than 8 that travels from the formation to the surface, a given quantity of return fluid as sampled at the surface and transferred to a cell, the pH of the quantity of fluid is measured, a given quantity of product acidifying the fluid is added to adjust the pH to a value of less than 4, the carbon dioxide level of the gas in the cells measured after the acidification step, and the quantity of carbon dioxide contained in the geologic formation is calculated from the carbon dioxide measurement.

The invention also relates to a device for implementing the method.

The patent to Jones et al. discloses a method of testing drilling mud which comprises periodically sampling the circulating mud and analyzing its aqueous filtrate at the rig site by ion chromatography for selected positive and negative ions. One or more other parameters of the sampled mud and/or mud filtrate, e.g., pH and temperature, may also be measured. As admitted by the Examiner, the Jones et al. patent does not disclose acidifying a quantity of sampled fluid and measuring the carbon dioxide level of a gas in a cell after the acidification step.

Significantly, the Jones et al. patent also does not disclose the step of calculating the quantity of CO<sub>2</sub> contained in the geologic formation from the CO<sub>2</sub> measurement. See, claim 1, last two lines. In fact, it appears one of the preferred purposes of the monitoring method disclosed in Jones et al. is to indicate downhole interactions so that the composition of the mud supplied to the hole can be adjusted to or towards the optimum as drilling proceeds. See, column 3, lines 52-57 of Jones et al. Nowhere is it disclosed or suggested that the quantity of CO<sub>2</sub> contained in the geologic formation can be calculated from CO<sub>2</sub> measured in return fluid according to the presently claimed method.

The Kelly et al. patent discloses a total carbon dioxide analyzer system that has a reaction chamber that includes a tube and a piston mounted for sliding movement in the tube to change the volume of the chamber. In operation, a sample to be analyzed and an acid reactant (that interacts with the sample to produce carbon dioxide) are flowed into the chamber by increasing the chamber volume, and a controller then seals the chamber by closing a valve. Carbon dioxide is then generated, the volume of the sealed chamber is increased, and the mixture is stirred to enhance the release of dissolved carbon dioxide into the gaseous phase. Then the quantity of carbon dioxide in the chamber is measured. It is disclosed that acid reagents such as lactic acid can be used to cause the final reaction mixture to have a pH of less than 3.0.

Nothing in Kelly et al would have provided any reason to calculate the quantity of CO<sub>2</sub> contained in a geologic formation from CO<sub>2</sub> measured in a return drilling fluid. Accordingly, even the proposed combination of Jones et al. and Kelly et al. would not have rendered obvious the method, including the step of calculating the quantity of CO<sub>2</sub> contained in the geologic formation from the CO<sub>2</sub> measurement in the return fluid, according to claimed method.

Moreover, while the Kelley et al. patent discloses that the invention is useful in measuring carbon dioxide content of many different fluids, including industrial waste, and industrial process fluids, in a particular embodiment, total carbon dioxide in serum and plasma is determined in a system that utilizes a sample volume of less than 50 microliters.

Applicants submit there would have been no apparent reason to combine the teachings of the Jones et al. and Kelley et al. patents in that the combined teachings

would not have rendered obvious in the presently claimed invention. In particular, nothing in the Jones et al. patent or the Kelley patent provides any apparent reason why one of ordinary skill in the art would have provided an additional monitoring function of the drilling mud in Jones et al. to monitor the carbon dioxide level. Moreover, noting the Kelley et al. patent, in a particular embodiment, is directed to measuring the total carbon dioxide in serum and plasma, it submitted there would have been no apparent reason why one of ordinary skill in the art would have looked to the teachings of Kelley et al. to modify the teachings of Jones et al. In addition, noting that the Kelley et al. patent is particularly directed to using a sample volume of less than 50 microliters, it is submitted there is no apparent reason why one of ordinary skill in the art would have employed the sampling method of Kelley et al. in the monitoring system of Jones et al.

For the foregoing reasons, it is submitted the presently claimed invention is patentable over the proposed combination of Jones et al. and Kelley et al.

Claim 4 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Jones et al. and Kelley et al. and further in view of U.S. Patent No. 4,397,957 to Allison. Applicants traverse this rejection and request reconsideration thereof.

The Allison patent discloses a method for determining the concentration of carbonate salts in solutions containing other inorganic salts. The method includes converting the carbonate salts to carbon dioxide by acidifying the sample, sweeping the acidified solution with an inert gas to strip the carbon dioxide from the solution and contacting an ion-selective gas-sensing electrode with the gas stream. The electrode includes a buffered solution which changes in pH depending on the concentration of carbon dioxide in the gas stream thereby providing a measure of the carbonate salt

concentration in the sample. The intent of Allison is to measure the carbonate salt concentration in the sample, not the quantity of CO<sub>2</sub> contained in a geologic formation. Thus, Allison does not remedy any of the basic deficiencies of Jones et al and Kelley et al noted above. The teaching of sweeping the acidified solution with an inert gas to strip carbon dioxide converted from the carbonate salts from the solution in no way provides a reason to sweep any gas in the process of Jones et al or Kelley et al. It is not clear why one of ordinary skill in the art would have a reason to sweep a gas in either of these processes. Accordingly, claim 4 is patentable over the proposed combination of references for this additional reason.

Claim 5 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Jones et al. and Kelley et al. and further in view of U.S. Patent No. 4,994,117 to Fehder. Applicants traverse this rejection and request reconsideration thereof.

The Examiner has cited the Fehder patent for the following teaching:

Each of the components in the detector is calibrated by selecting one or more of three parameters of the indicating element, namely:

1. the nature of the base;
2. the concentration of the base in the solution used to impregnate the carrier. This parameter provides the initial pH of the solution in equilibrium or steady state with the baseline concentration of carbon dioxide; and
3. the pK of the chromogenic pH-sensitive indicator.

However, clearly nothing in Fehder remedies any of the basic deficiencies of Jones et al and Kelley et al noted above. Accordingly, claim 5 is patentable over the proposed combination of references at least for the reasons noted above.

Claims 7-12 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Jones et al. and Kelley et al. and further in view of Allison. Applicants traverse this rejection and request reconsideration thereof.

Claims 7-12 are directed to the device of the present invention for estimating the quantity of CO<sub>2</sub> present in a geologic formation traversed by a well in which a drilling fluid with a pH greater than 8 travels between said formation and the wellhead at the surface, characterized in that it comprises means for sampling a given quantity of fluid at the wellhead, a cell to hold said quantity of fluid, means for measuring the pH in said cell, means for inert-gas scavenging of the internal space of the cell, means for injecting an acidifying product into said cell, and means for measuring the quantity of CO<sub>2</sub> contained in the internal space of the cell.

As admitted by the Examiner, the Jones et al. patent does not disclose means for acidifying a quantity of sampled fluid and means for measuring the carbon dioxide level of a gas in a cell after the acidification step.

While the Kelley et al. patent discloses that the invention is useful in measuring carbon dioxide content of many different fluids, including industrial waste, and industrial process fluids, in a particular embodiment, total carbon dioxide in serum and plasma is determined in a system that utilizes a sample volume of less than 50 microliters.

Applicants submit there would have been no apparent reason to combine the teachings of the Jones et al. and Kelley et al. patents in that the combined teachings would not have rendered obvious in the presently claimed invention. In particular, nothing in the Jones et al. patent or the Kelley patent provides any apparent reason why one of ordinary skill in the art would have provided an additional monitoring means for monitoring of the drilling mud in Jones et al., i.e., means for measuring the carbon dioxide level. Moreover, noting the Kelley et al. patent, in a particular embodiment, is directed to measuring the total carbon dioxide in serum and plasma, it submitted there

would have been no apparent reason why one of ordinary skill in the art would have looked to the teachings of Kelley et al. to modify the teachings of Jones et al. In addition, noting that the Kelley et al. patent is particularly directed to using a sample volume of less than 50 microliters, it is submitted there is no apparent reason why one of ordinary skill in the art would have employed the sampling means of Kelley et al. in the monitoring system of Jones et al.

For the foregoing reasons, it is submitted the presently claimed invention is patentable over the proposed combination of Jones et al. and Kelley et al. Accordingly, claims 7-12 are patentable over the proposed combination of references.

In view of the foregoing remarks, favorable reconsideration and allowance of all of the claims now in the application are requested.

To the extent necessary, applicants petition for an extension of time under 37 CFR 1.136. Please charge any shortage in the fees due in connection with the filing of this paper, including extension of time fees, to the deposit account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (Case: 612.43540X00), and please credit any excess fees to such deposit account.

Respectfully submitted,

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